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DIVISION OF ENGINEERING SERVICES
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ROTATIONAL VISCOSITY MEASUREMENT OF ASPHALT RUBBER BINDER

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “**SAFETY AND HEALTH**” in Section I of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

OVERVIEW

This method presents procedures for sampling and physical testing of asphalt rubber binder in the field using a hand held portable rotational analog or digital viscometer.

2. APPARATUS

- 2.1 Viscometer – Hand held high range rotational viscometer. Analog models with indicator needles and scaled dial displays and digital read out viscometers may be used.
- 2.2 Rotor – a cylinder with diameter of 24 ± 0.1 mm, height of 53 ± 0.1 mm, and vent hole attached to a spindle or shaft with length of 87 ± 2 mm that is compatible with the selected viscometer.

NOTE 1: Suitable analog viscometer models include Rion Model VT-04E, Haake Model VT-02, or equivalent. Suitable rotors include Rion No. 1, Haake No. 1, or equivalent.

- 2.3 Thermometer – Digital with metal jacket probe, 1°F precision.
- 2.4 Sample Containers – Clean 1 gallon metal cans with lids and wire bale.
- 2.5 Viscosity Standard Oils – Fluids calibrated in absolute viscosity millipascal seconds (mPa·s).
- 2.6 Viscometer holder – clean metal container or stand for safely storing the viscometer between tests.
- 2.7 Level surface not directly on the ground.
- 2.8 Controllable heat source, such as a hot plate, gas stove or burner, etc., to maintain the temperature of the asphalt rubber sample at $375^{\circ}\text{F} \pm 3^{\circ}\text{F}$ while measuring viscosity.
- 2.9 Eye protection and heat resistant gloves.

3. CALIBRATION VERIFICATION PROCEDURE

Calibration of the rotational viscometer shall be verified using viscosity standards prior to use at each site.

- 3.1 The accuracy of the viscometer shall be verified by comparing the viscosity results obtained with the hand held viscometer to 3 separate calibration fluids of known viscosities ranging from 1000 to 5000 Pa • s ($\times 10^{-3}$) (1000 to 5000 mPa•s, **see NOTE 2**).
- 3.2 The viscometer will be considered accurate if the values obtained are within 300 Pa • s ($\times 10^{-3}$) of the known viscosity.
- 3.3 The known viscosity value shall be based on the fluid manufacturer's standard test temperature or the test temperature versus viscosity correlation table provided by the fluid manufacturer.

4. PREPARING ASPHALT RUBBER BINDER SAMPLES FOR VISCOSITY TESTING

- 4.1 The sample shall be immediately transported to the testing area. The testing area should be reasonably close to the sampling locations to reduce potential for temperature loss.
- 4.2 The open asphalt rubber binder sample container shall be set on a level surface, on or over the heat source as appropriate.
- 4.3 To prevent scorching or burning, the asphalt rubber sample shall be manually stirred using an appropriate metal stir rod or the temperature probe.
- 4.4 Stirring shall continue until a consistent binder temperature of $375^{\circ}\text{F} \pm 3^{\circ}\text{F}$ is achieved. The actual test temperature shall be recorded with the corresponding viscosity measurement.
- 4.5 The viscometer spindle and rotor shall be inserted in the hot binder sample near the edge of the can, no deeper than the immersion depth mark on the shaft, and without plugging the vent hole. It is permissible to tilt the spindle and rotor slightly during insertion to help keep the vent hole clear.
- 4.6 Allow the rotor to acclimate to the temperature of the binder for approximately 1 minute. During acclimation, stir the sample thoroughly and measure its temperature.
- 4.7 Orient the sample and the rotor so that the rotor is near the center of the sample, align the depth mark on the shaft with the binder surface, and level the viscometer in order to measure viscosity.

5. TESTING USING ANALOG VISCOMETERS

Hand held analog viscometers include a level bubble to help orient the device so that the rotor and shaft remain vertical.

- 5.1 As soon as the viscometer is leveled and the depth mark is even with the binder surface, begin rotor rotation. Read and record the peak viscosity value from the graduated scale labeled with the corresponding rotor number. **SEE NOTES 2 and 3.**

NOTE 2: Some of the meters read in units of mPa•s (0.001 Pascal•seconds (Pa•s)) or dPa•s (0.1 Pa•s); others may read in centipoise (cPs) units. Conversion to cPs units is as follows:

$$1 \text{ Pa}\cdot\text{s} = 1000 \text{ cPs}$$

$$1 \text{ dPa}\cdot\text{s} = 0.1 \text{ Pa}\cdot\text{s} = 1000 \text{ cPs}/10$$

$$1 \text{ dPa}\cdot\text{s} = 100 \text{ cPs}$$

$$1 \text{ mPa}\cdot\text{s} = 0.001 \text{ Pa}\cdot\text{s} = 1000 \text{ Ps}/1000 \\ = 1 \text{ cPs}$$

NOTE 3: The peak measurement typically represents the viscosity of the asphalt rubber binder and that is the value that shall be reported and logged. As the rotor continues to turn, it “drills” into the sample and spins rubber particles out of its measurement area, which may cause thinning of the material in contact with the rotor and lead to erroneous results that indicate a drop in the apparent viscosity of the asphalt rubber.

- 5.2 After completing the first measurement, move the viscometer rotor away from the center of the sample can without removing it from the asphalt rubber binder sample. Turn off rotor rotation.
- 5.3 Stir the asphalt rubber sample thoroughly and repeat Steps 1, 2 and 3. A total of three measurements shall be taken and averaged to determine the viscosity.
- 5.4 Return the viscometer to its holder with the rotor suspended in a suitable solvent. Before using the rotor again, wipe off the solvent and dry the rotor to avoid solvent contamination of the next sample.

6. TESTING USING DIGITAL VISCOMETERS

Hand held digital viscometers currently available do not include a level bubble to help orient the device so that the rotor and shaft remain vertical. A small adhesive bubble may be attached to the viscometer, or a framework with level bubble(s) may be used to hold the viscometer in the proper orientation for measuring viscosity.

- 6.1 As soon as the viscometer is leveled and the depth mark is even with the binder surface, begin rotor rotation and activate the continuous digital display according to the manufacturer’s instructions. Read the digital display and record the peak viscosity value. **SEE NOTES 2 and 3.**
- 6.2 After completing the first measurement and without removing the rotor from the asphalt rubber binder sample, move the viscometer rotor or the sample container so that the rotor is no longer in the center of the sample can. Turn off rotor rotation.
- 6.3 Stir the asphalt rubber sample thoroughly and repeat Steps 1, 2, and 3. A total of three measurements shall be taken and averaged to determine the viscosity.
- 6.4 Return the viscometer to its holder with the rotor suspended in a suitable solvent. Before using the rotor again, wipe off the solvent and dry the rotor to avoid solvent contamination of the next sample.

7. REPORT

The report shall normally include the following items. Where applicable, data may be recorded on a test summary sheet. Items 1, 2, and 9 must be recorded for each individual test performed, but the other information may be included in preprinted sheets.

- 7.1 Operator
- 7.2 Date and time sampled

- 7.3** Location of asphalt rubber blending plant
- 7.4** PG Asphalt Grade and Supplier(s)
- 7.5** CRM Supplier(s)
- 7.6** Asphalt modifier type and supplier
- 7.7** Asphalt rubber blender/supplier
- 7.8** If used in RAC, RAC supplier(s)
- 7.9** Test temperature and viscosity
- 7.10** Rotor designation
- 7.11** Viscometer model and serial number

8. SAFETY AND HEALTH

- 8.1** This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
- 8.2** Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

Project Name/Number	
Asphalt Rubber (AR) Blender/Supplier	
Location of AR Blending Plant	
RAC Mix Supplier	

ASPHALT RUBBER BINDER FORMULATION

Blend Proportions

Asphalt Cement PG Grade and Supplier		
Asphalt Modifier Type and Supplier		% by AC mass:
Asphalt Cement and Modifier		% by Asphalt Rubber Binder mass:
Scrap Tire CRM Type & Supplier		% by Asphalt Rubber Binder mass:
High Natural CRM Source & Description		% by Asphalt Rubber Binder mass:

Asphalt Rubber Binder (ARB) material must be tested to verify compliance with minimum viscosity requirement of 1,500 Pa•s ($\times 10^{-3}$) at 375 \pm 3°F before it can be used.

*Cycle Start Date & Time	AR Batch #	Temperature In ARB Tank (°F)	Temp. During Viscosity Test (°F) (350 \pm 3°F)	MEASURED VISCOSITY** Pa•s($\times 10^{-3}$)	Date and Time Sampled	Date and Time Tested	Comments

Viscometer Make, Model and Serial #: _____
Rotor Designation: _____

Test Operator: _____

* The cycle begins when the asphalt rubber tank is fully loaded and temperature in the tank is 375 \pm 3°F.

** Measure viscosity at 375 \pm 3°F according to Caltrans LP-XX. Viscometer may read in units of centipoises (cPs) or dPa•s. Unit conversions are as follows:

1Pa•s = 1,000 cPs

1dPa•s = 0.1Pa•s = 100 cPs

1mPa•s = 0.001Pa•s = 1 cPs